

# Modeling and Data Analysis of TRACE-P Data

## Photochemical Box Modeling

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## 3-D Global and Regional Modeling

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Interests:

Fast Photochemical Testing

Photochemical Budgets

Photochemical Evolution

Stratosphere-Troposphere Exchange

Regional Photochemistry and Transport

# TRACEP Tropopause O3 Flux Calculation

The cross-tropopause mass transport  $F(\rho)$  is given by Eq. (18) of Wei (1987)

$$F(\rho) = \rho J_{\theta} \left[ \underbrace{d\theta/dt}_{\text{Diabatic transport}} - \underbrace{\delta\theta/\delta t_{zt}}_{\text{Movement of Tropopause}} - \underbrace{u\delta\theta/\delta x_{zt} - v\delta\theta/\delta y_{zt}}_{\text{Isentropic Horizontal Transport}} \right]$$

where the subscript  $zt$  indicates evaluation on the tropopause surface and

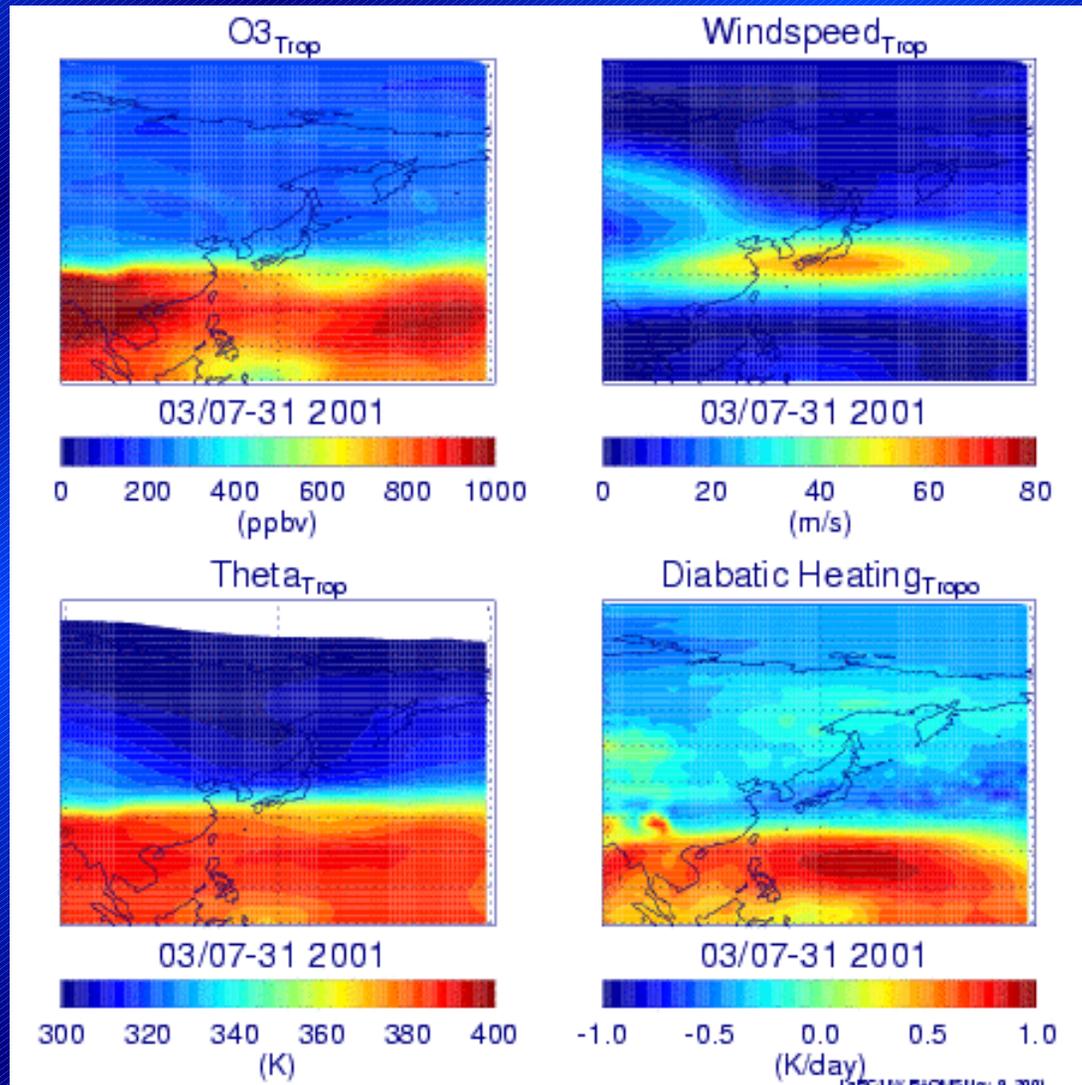
$$\rho J_{\theta} = -1/g [\delta p / \delta \theta]$$

The O3 Flux is given by **O3\* F(ρ)**

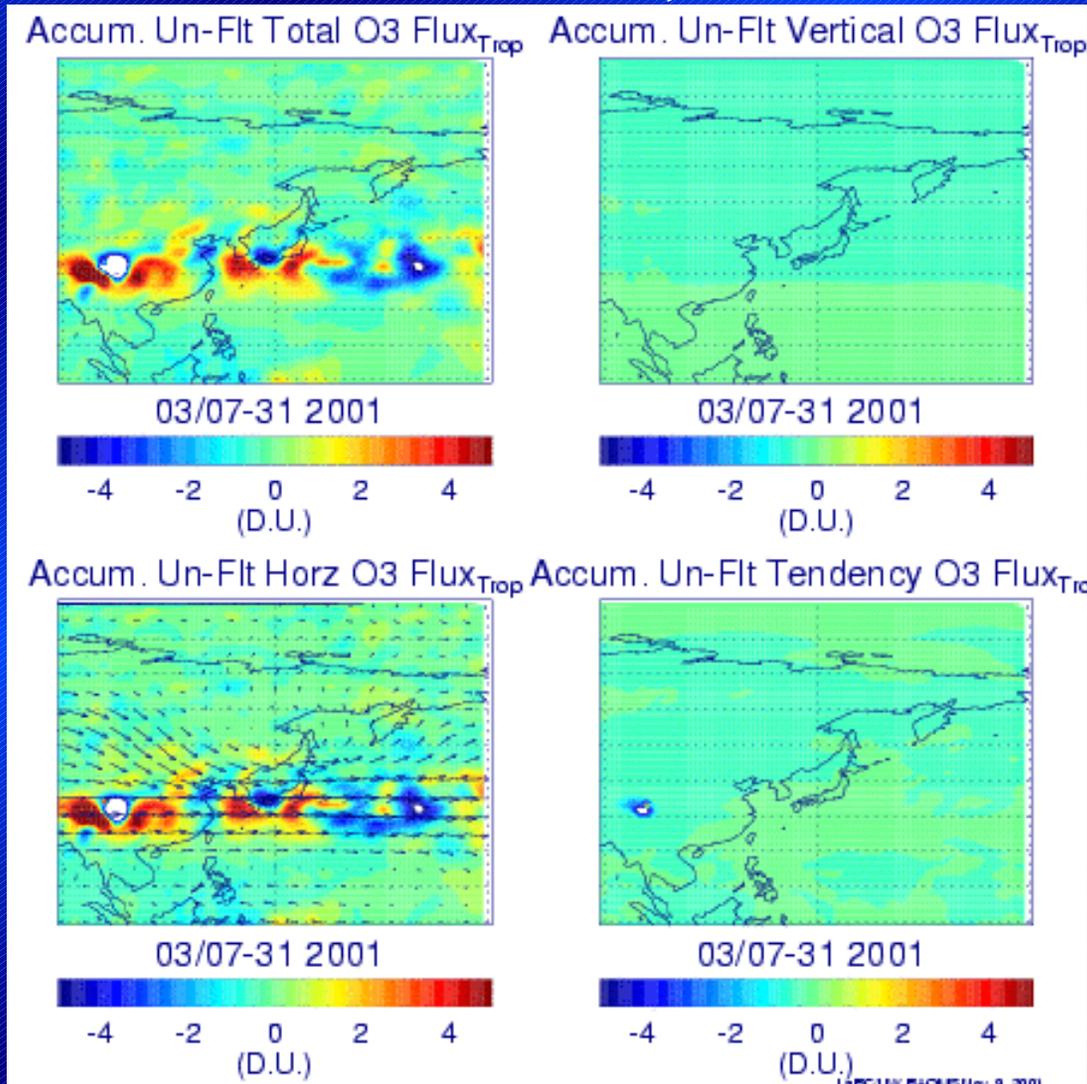
# Auxiliary Data

- Diabatic heating rates and ozone distribution from 2x2° RAQMS UW-Hybrid model simulation (online-chemistry with 6hr re-initialization from NOAA AVN assimilation)
- 6hr Winds and Temperatures from 1x1 NOAA AVN assimilation
- Thermal tropopause (2K/km lapse-rate)

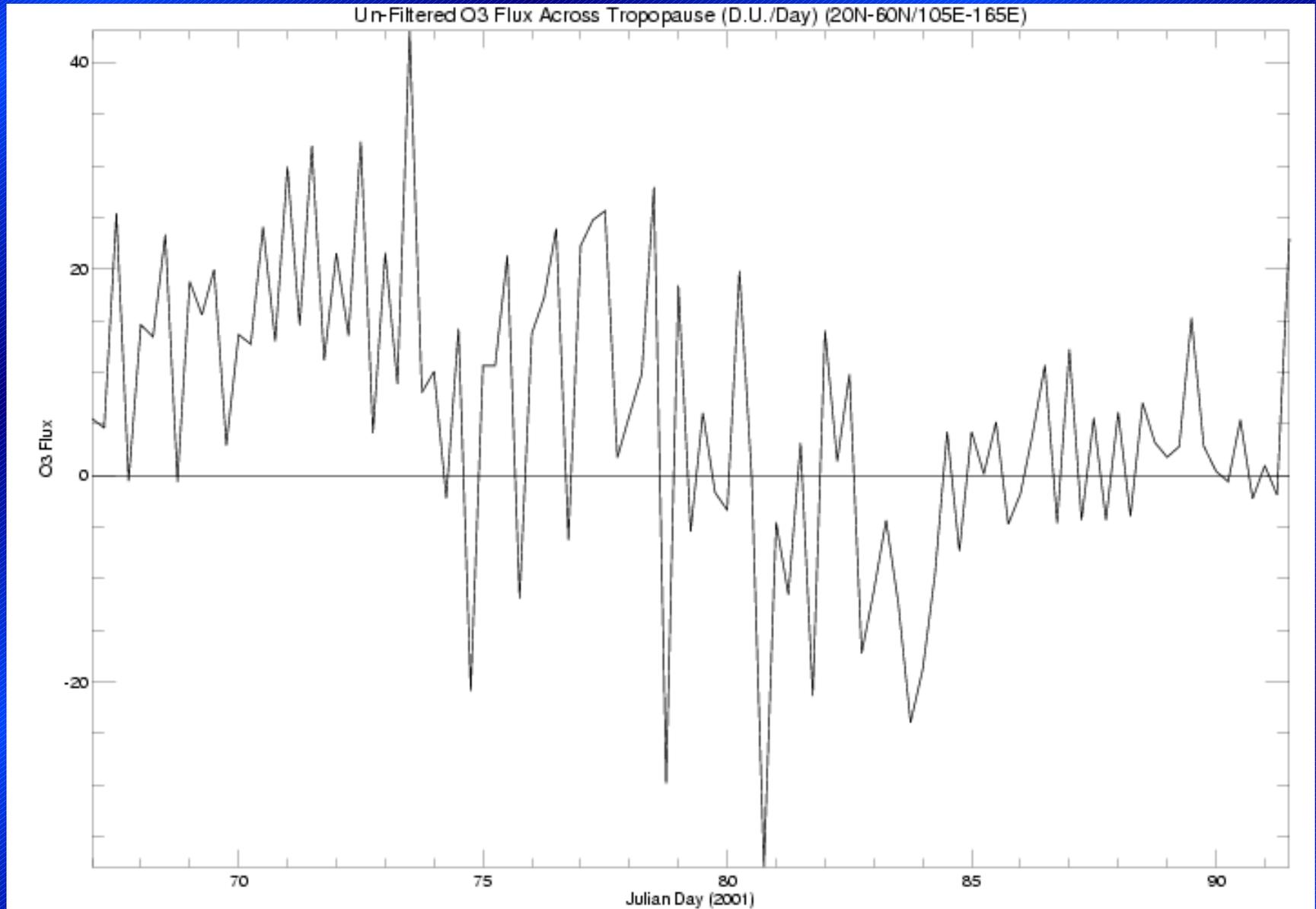
# Tropopause Diagnostics: 03/07-03/31, 2001



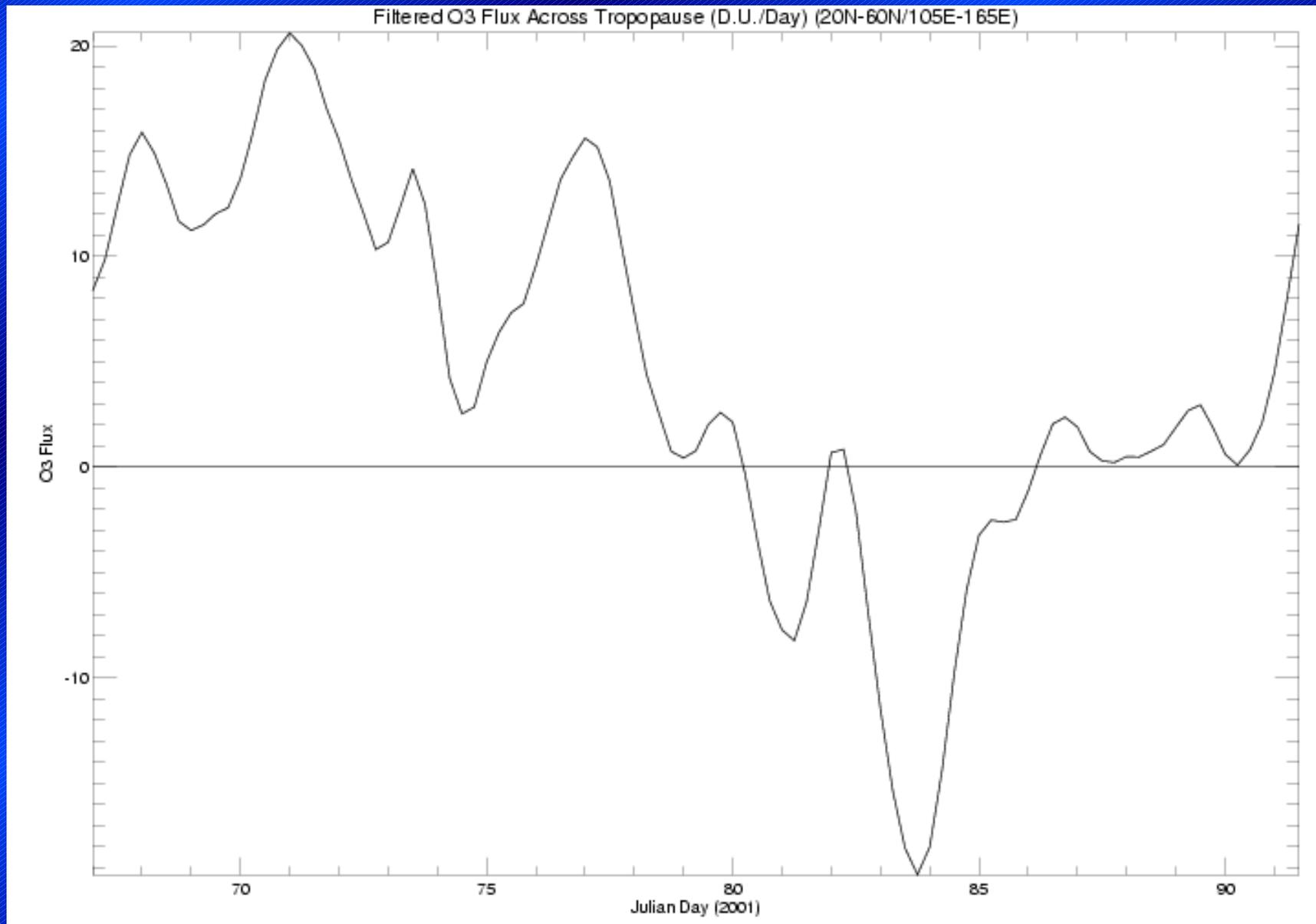
# Un-Filtered Accumulated O3 Flux 03/07-03/31, 2001



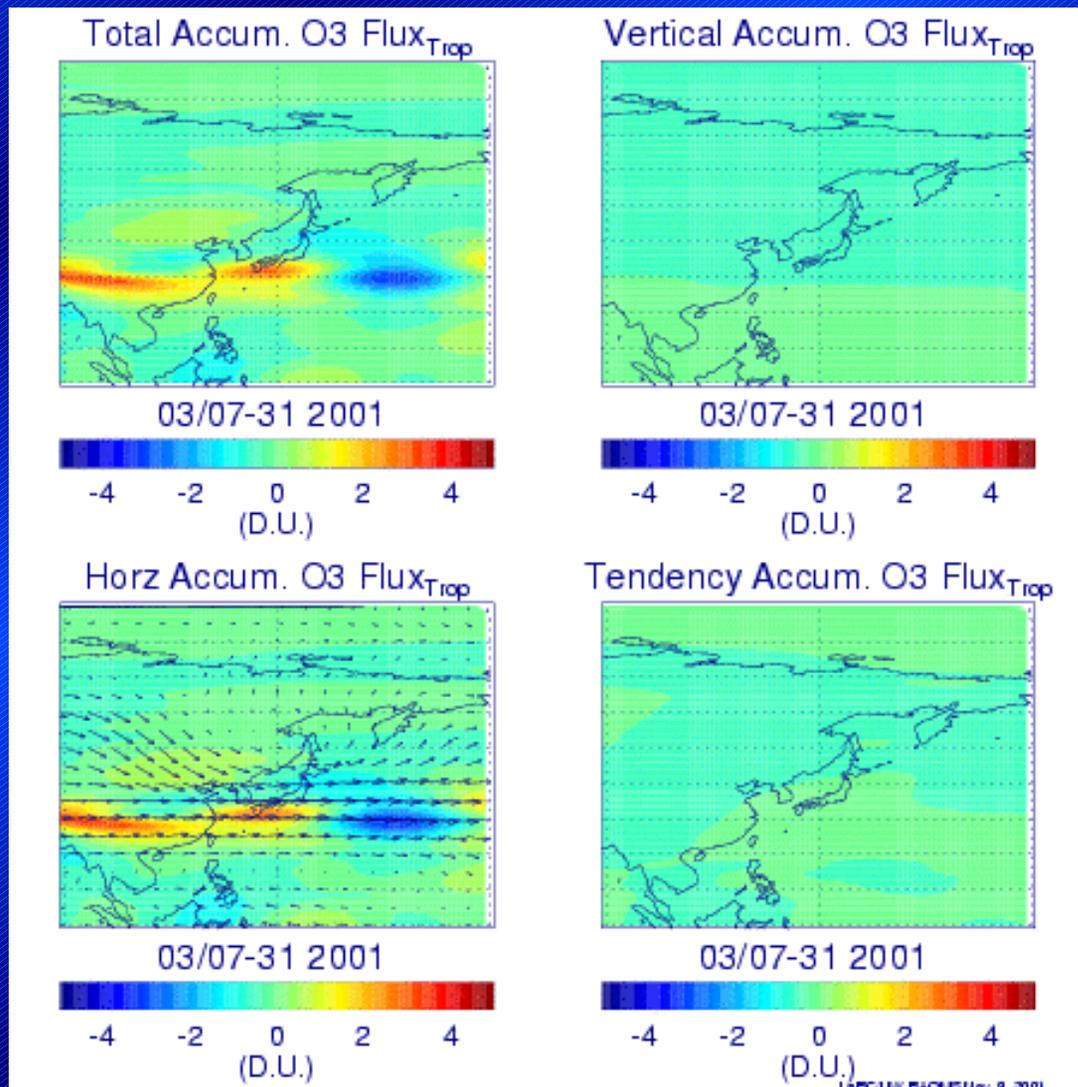
# Un-Filtered O3 Flux Timeseries



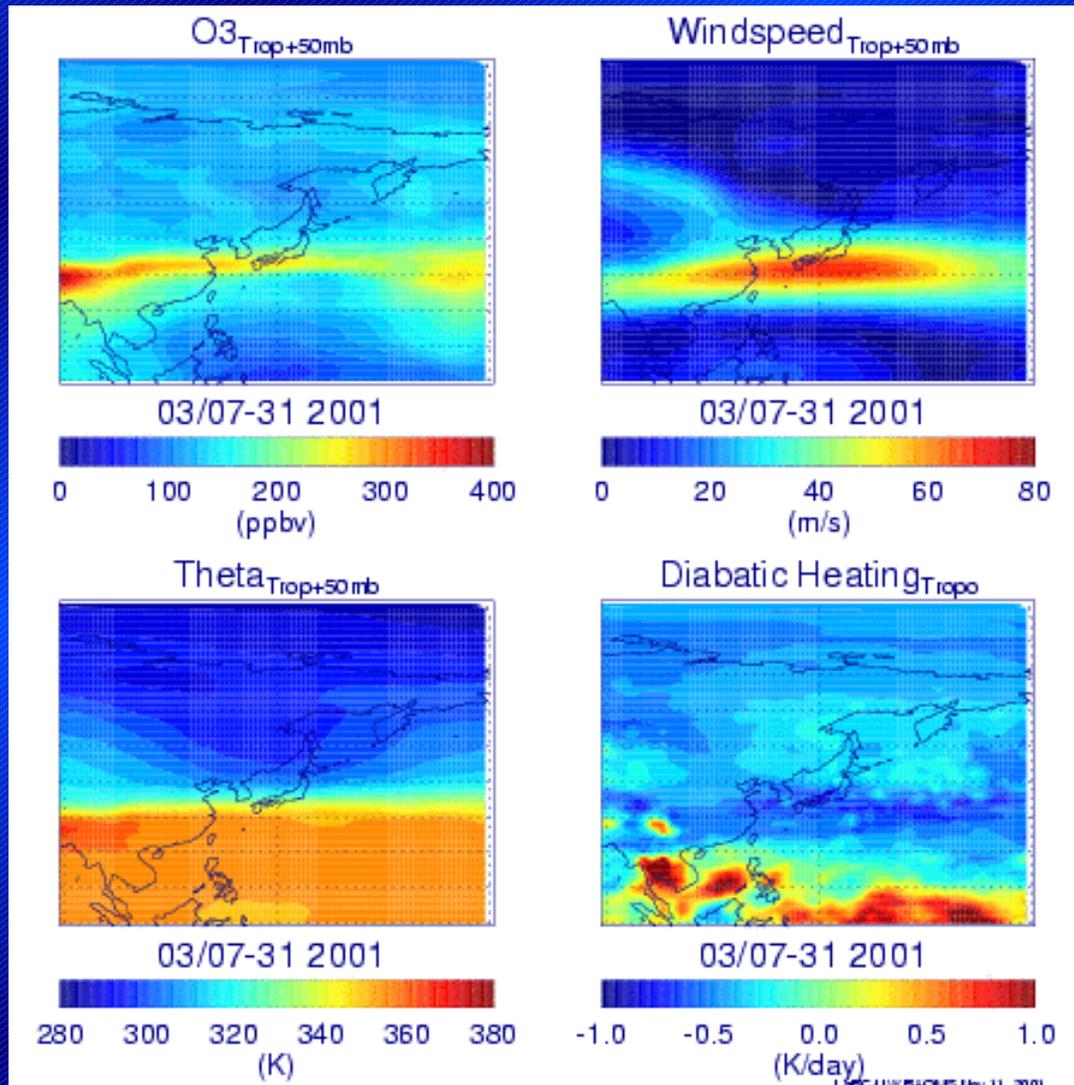
# 6hr Filtered O3 Flux timeseries



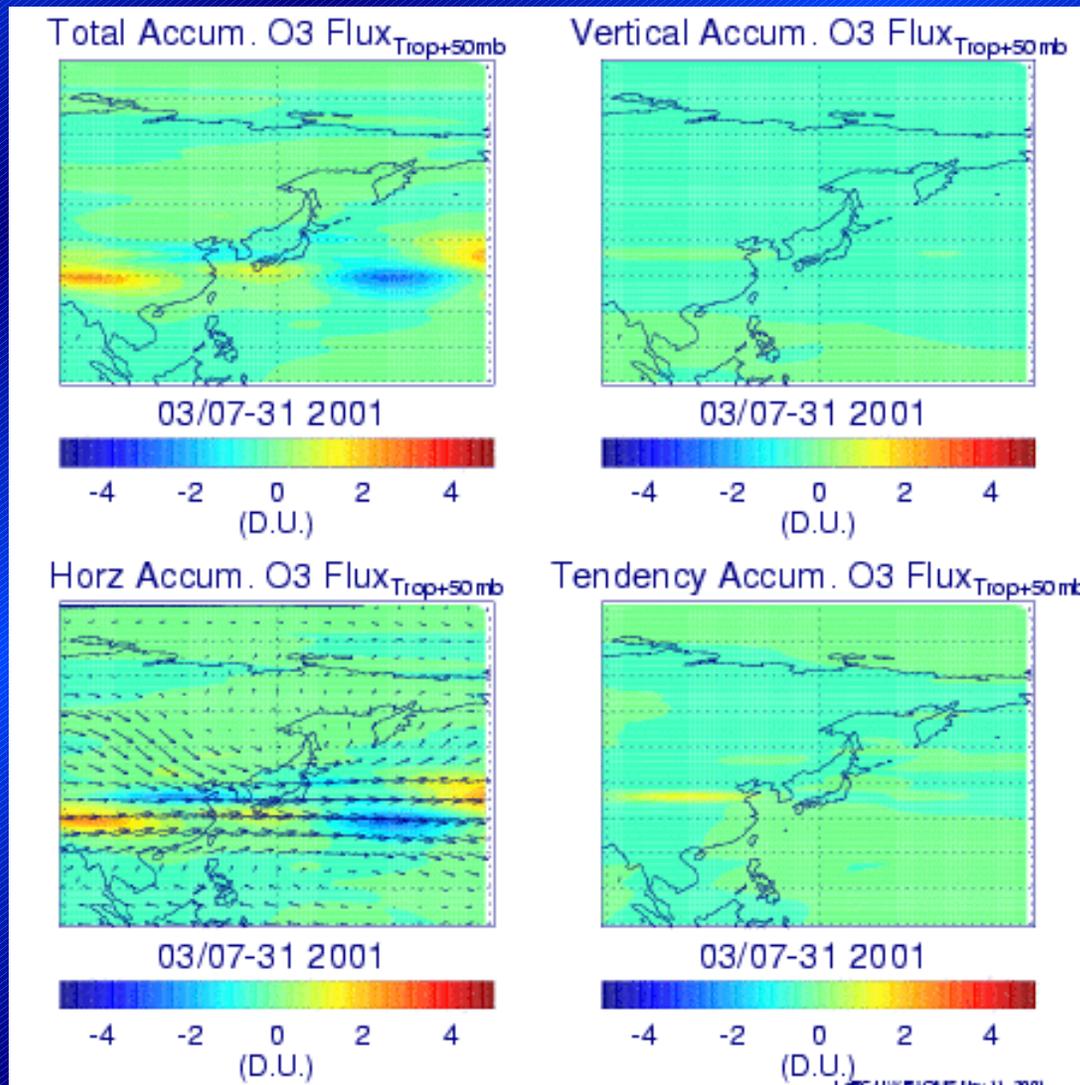
# Time/Space Filtered Accumulated O3 Flux: 03/07-03/31, 2001



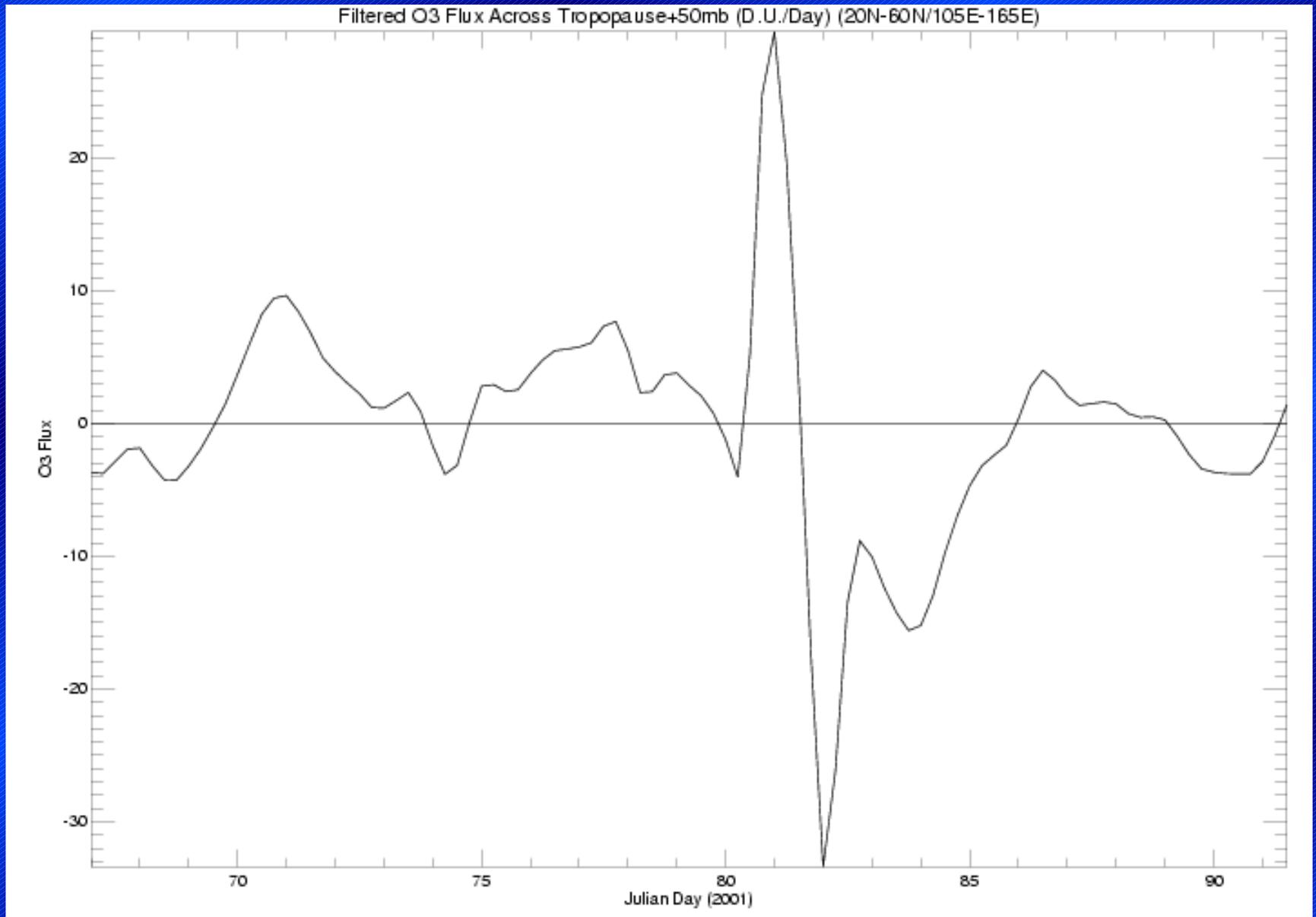
# Tropopause+50mb Diagnostics: 03/07-03/31, 2001



# Time/Space Filtered Accumulated O3 Flux (Trop+50mb): 03/07-03/31, 2001

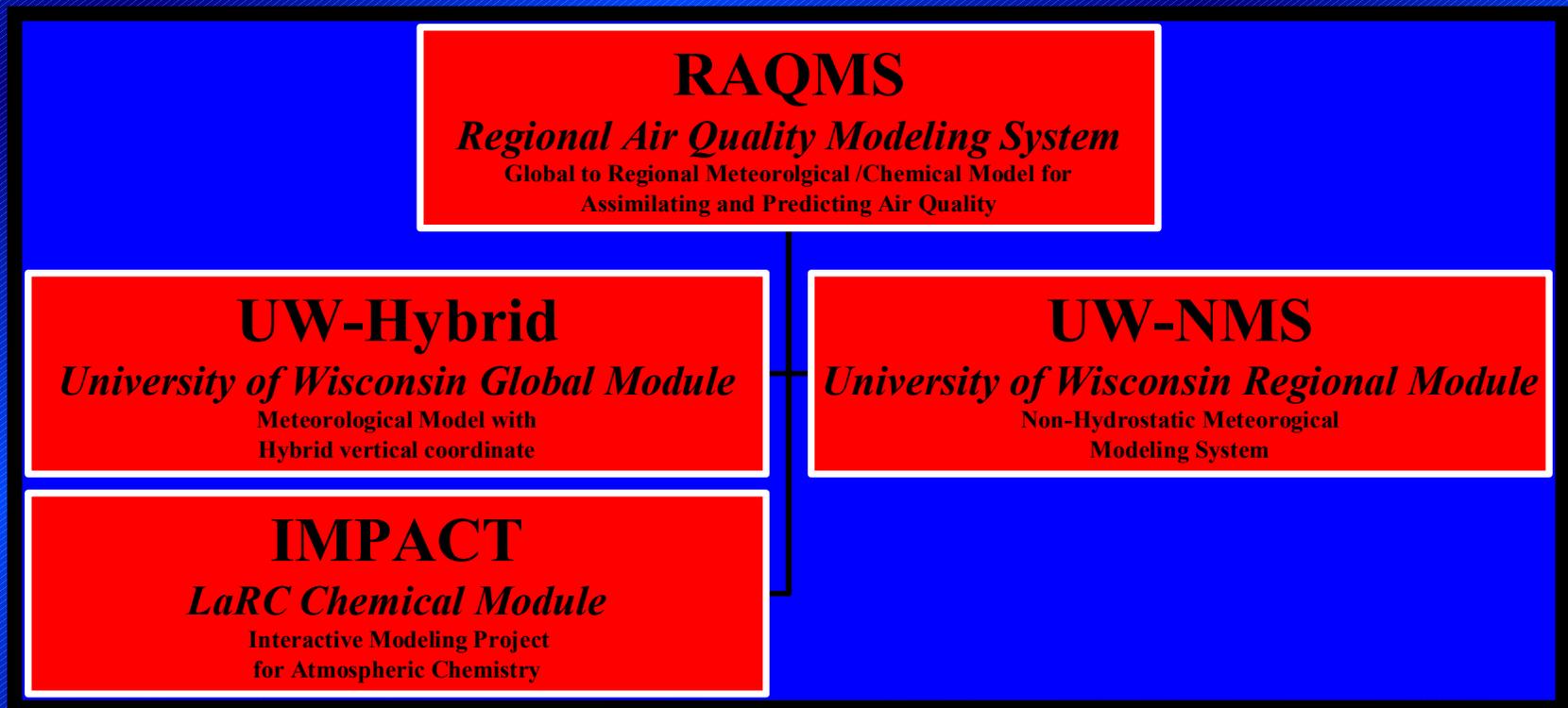


# 6hr Filtered O3 Flux timeseries



# LaRC/UW

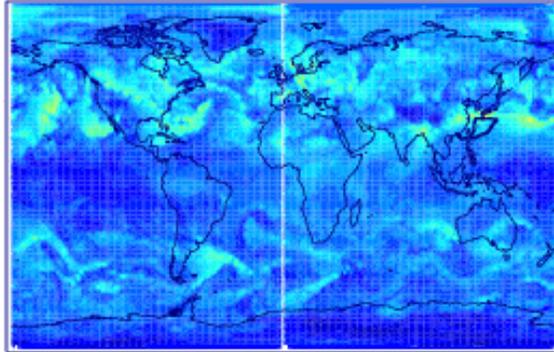
## Regional Air Quality Modeling System



# Tropospheric Column Evolution

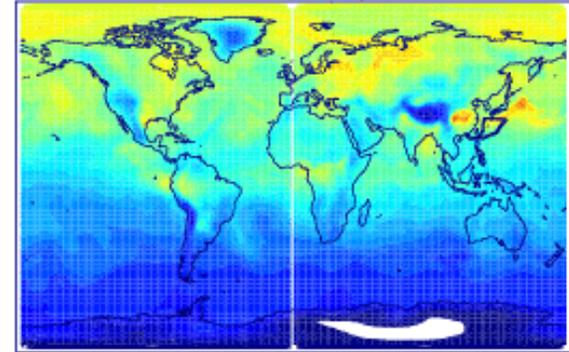
Initial  
Conditions:  
RDF Map

Trop O3 Column 03/07, 06Z, 2001



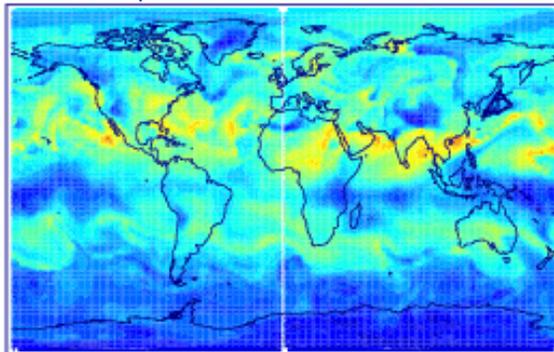
0 10 20 30 40 50 60  
(Dobson Units)

CO Column 03/07, 06Z, 2001



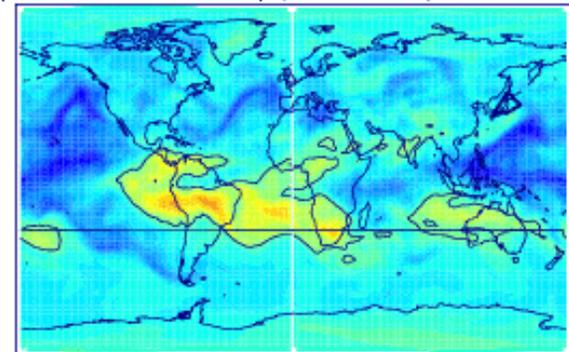
0.5 1.0 1.5 2.0 2.5  
( $10^{18}$  mol/cm<sup>2</sup>)

Trop O3 Column 03/30, 06Z, 2001



0 10 20 30 40 50 60  
(Dobson Units)

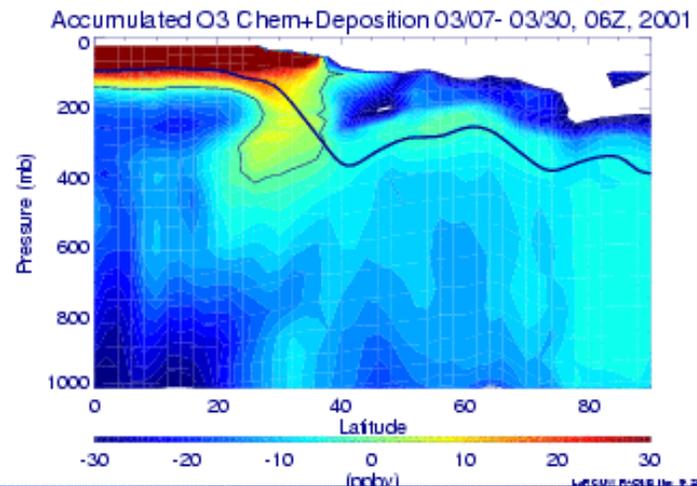
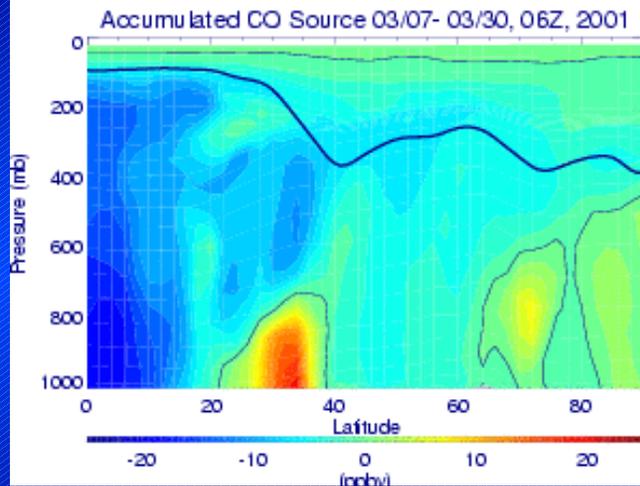
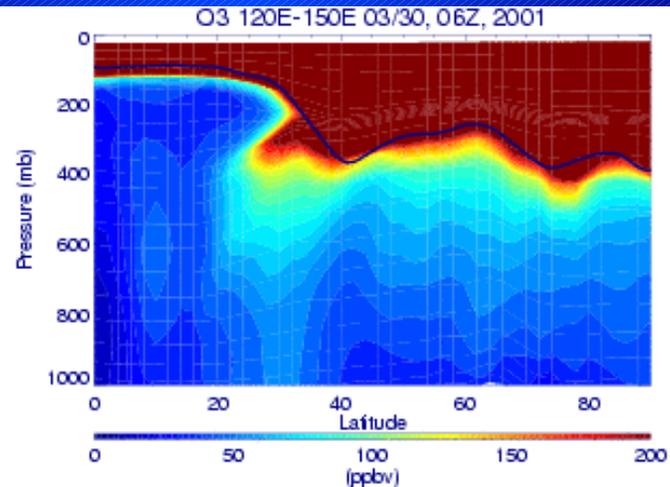
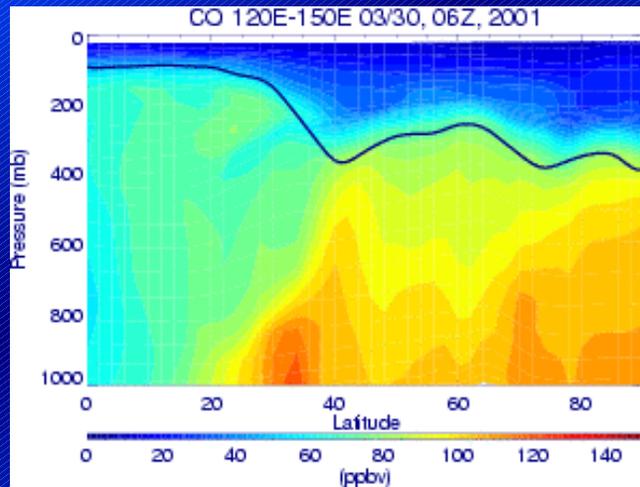
Trop O3 Column Chem+Dep (Accumulated) 03/30, 06Z, 2001



-20 -10 0 10 20  
(Dobson Units)

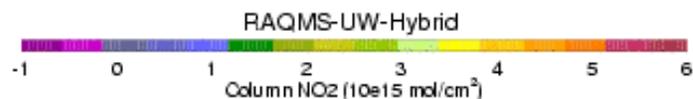
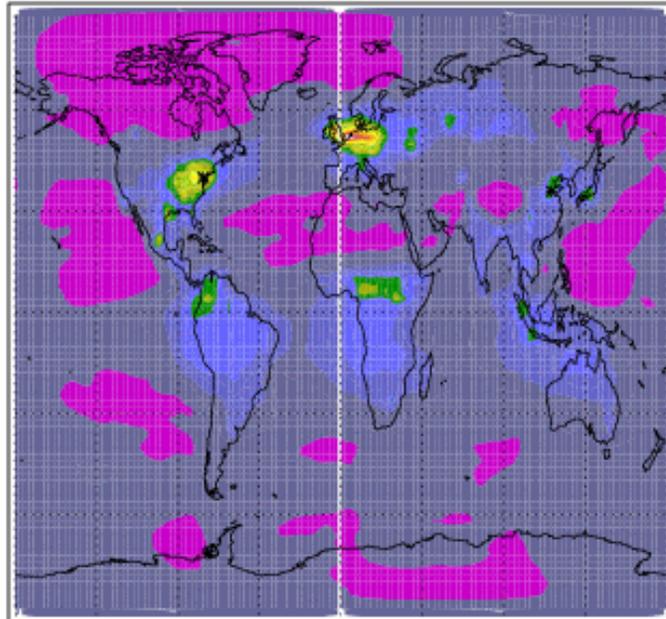
Final  
Conditions:  
23 day  
RAQMS  
Prediction

# 03/30/01 Cross-section: 120E-150E

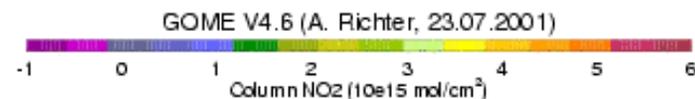
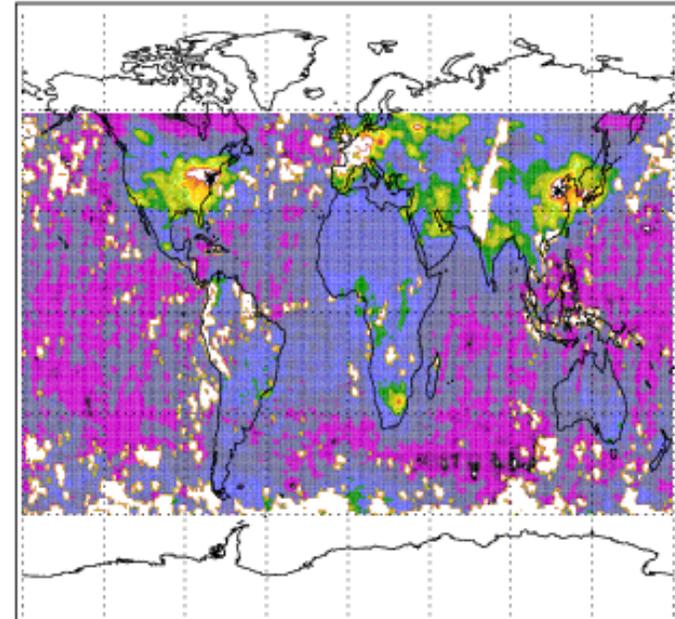


# RAQMS/GOME NO2 Intercomparison

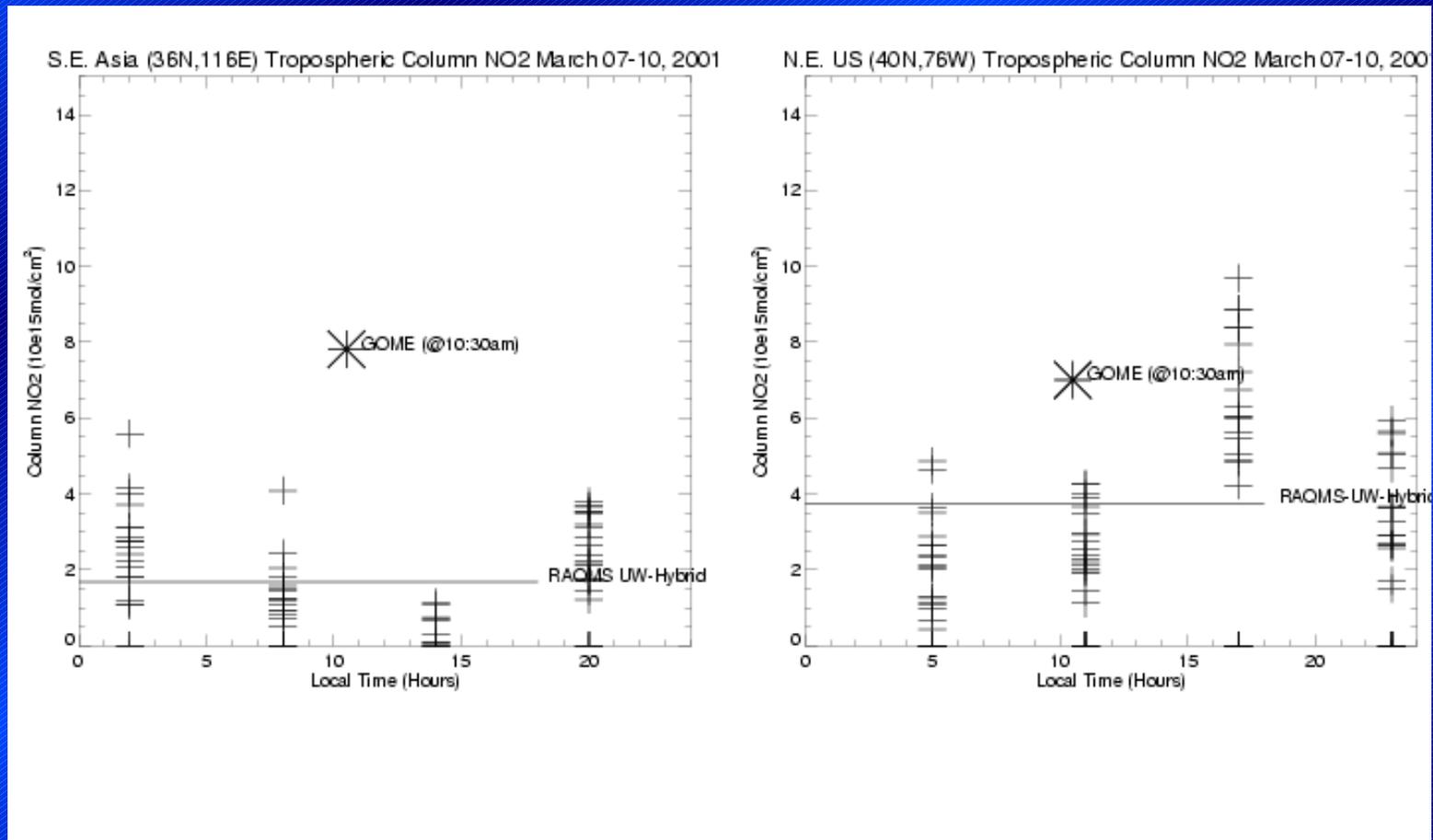
Predicted (Day-Ave) Tropospheric Column NO2 March 07-10, 2001



Observed (@10:30am) Tropospheric Column NO2 March 01-31, 2001

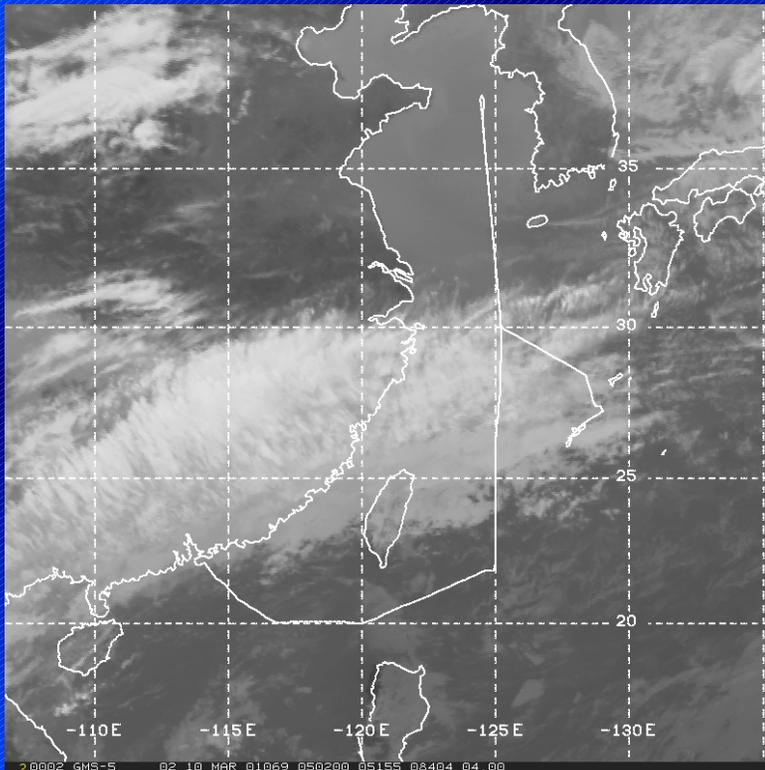


# RAQMS/GOME Timeseries

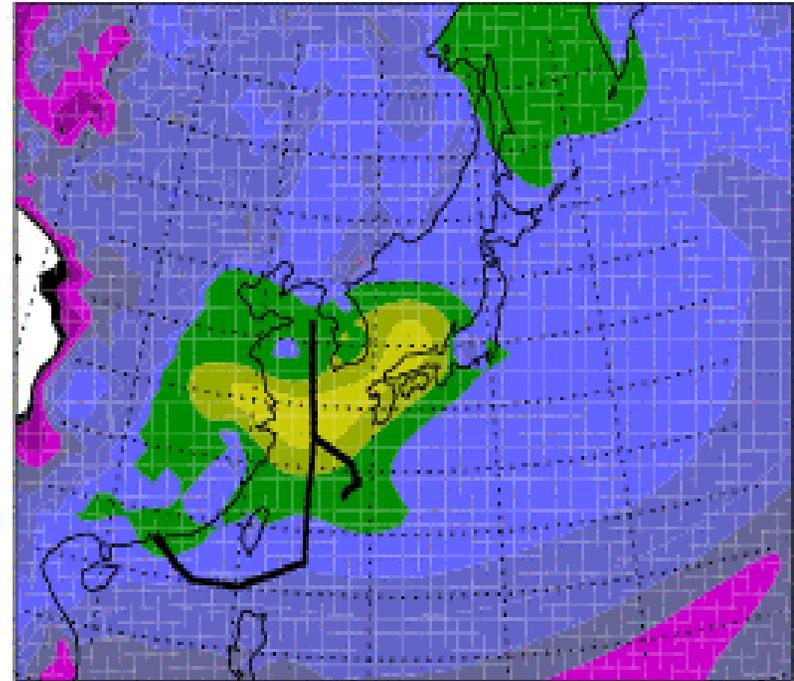


# Regional RAQMS Simulations

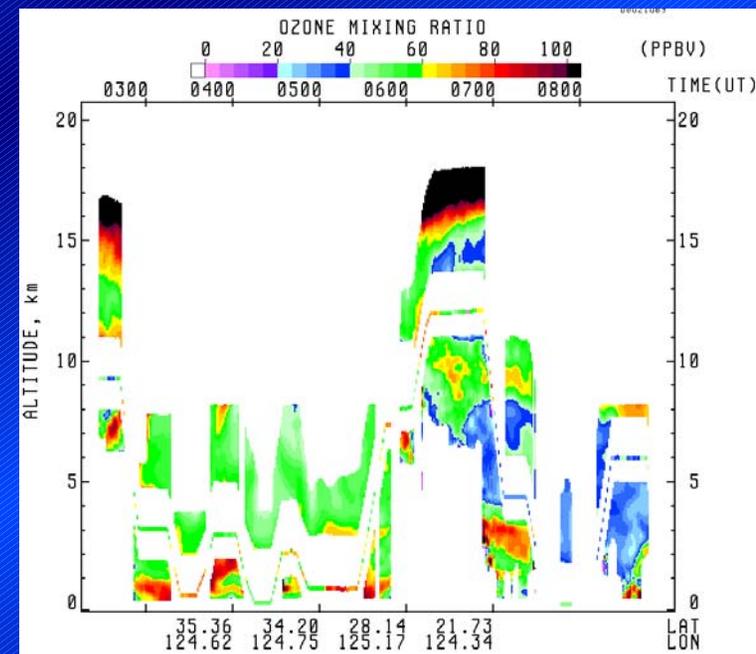
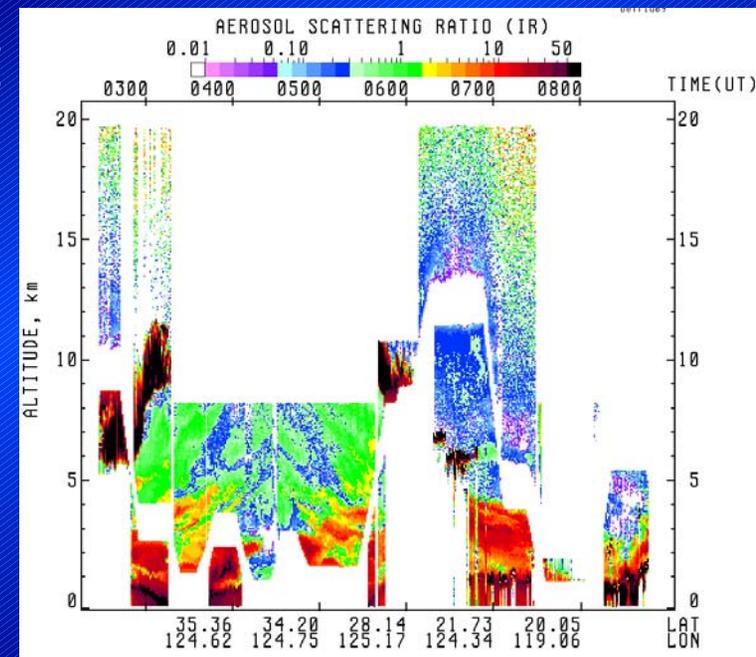
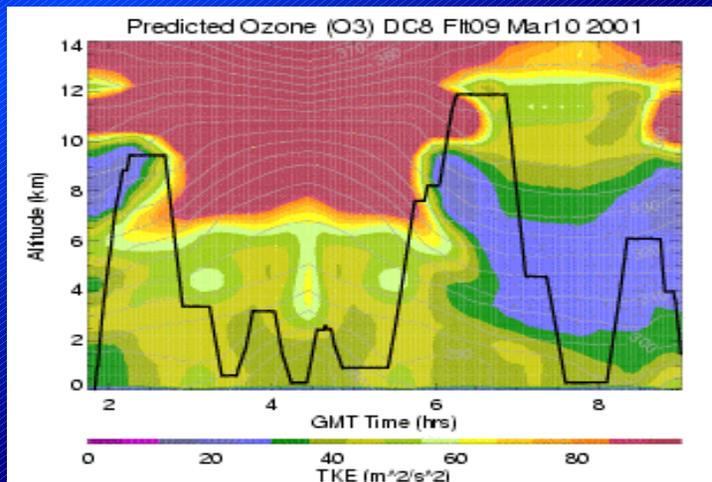
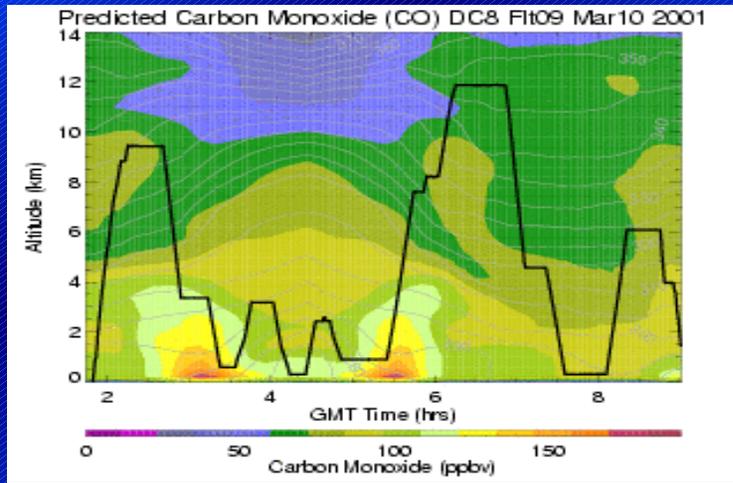
GMS IR Image 03/10/01



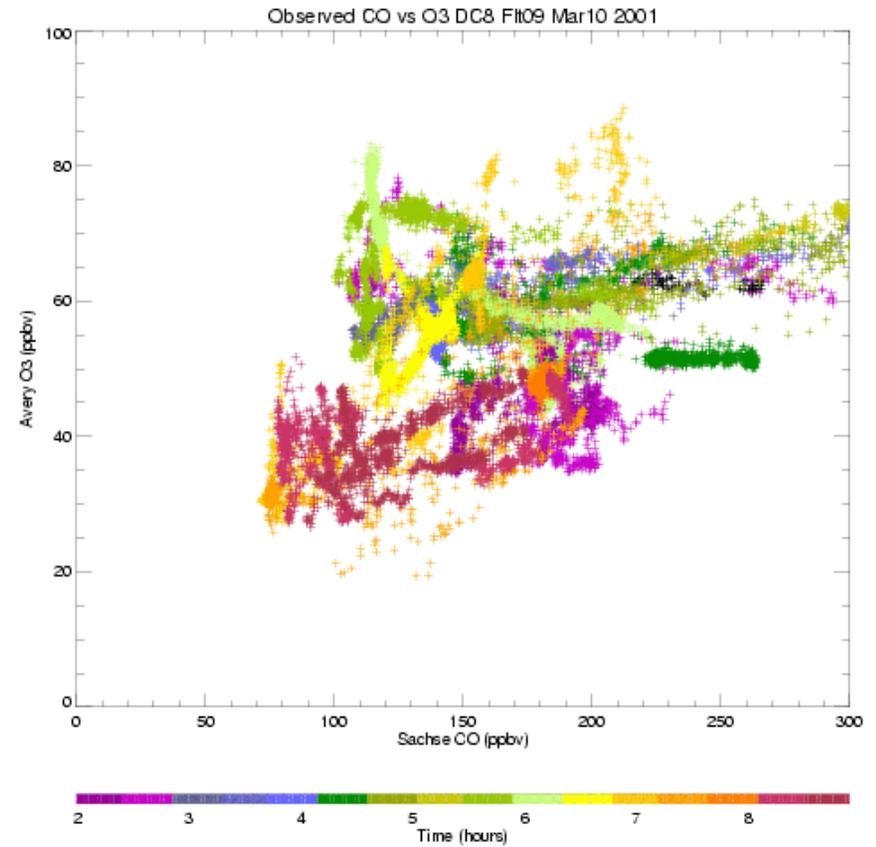
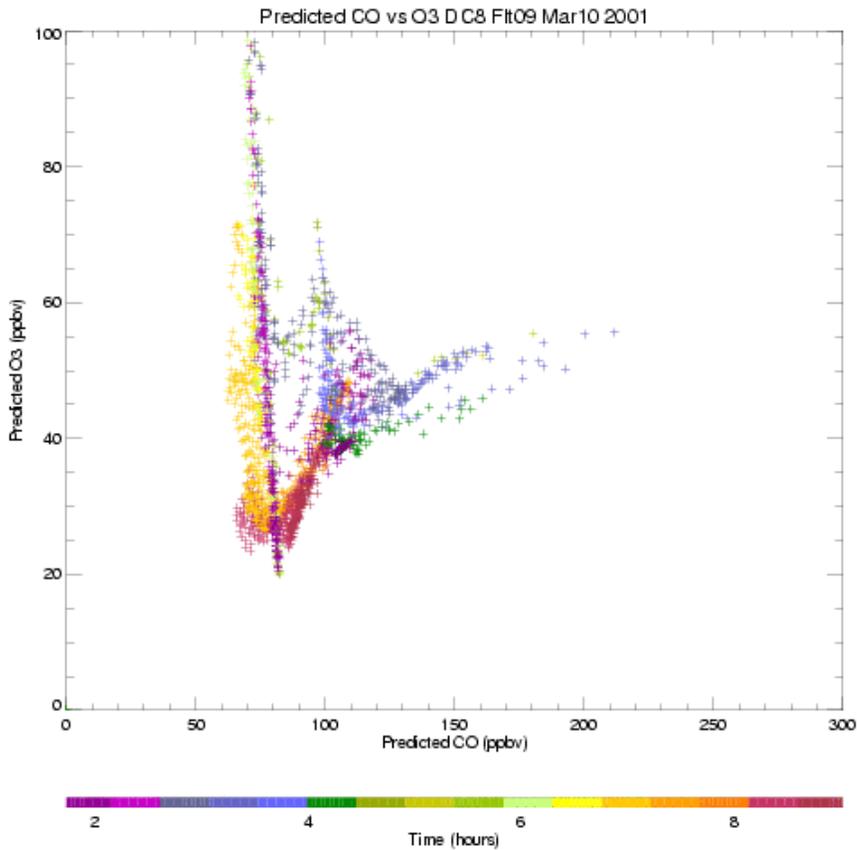
RAQMS-UWNMS Column CO DC8 Flt09 Mar10 2001



# RAQMS/DIAL Comparison: Flt 09 03/10/01

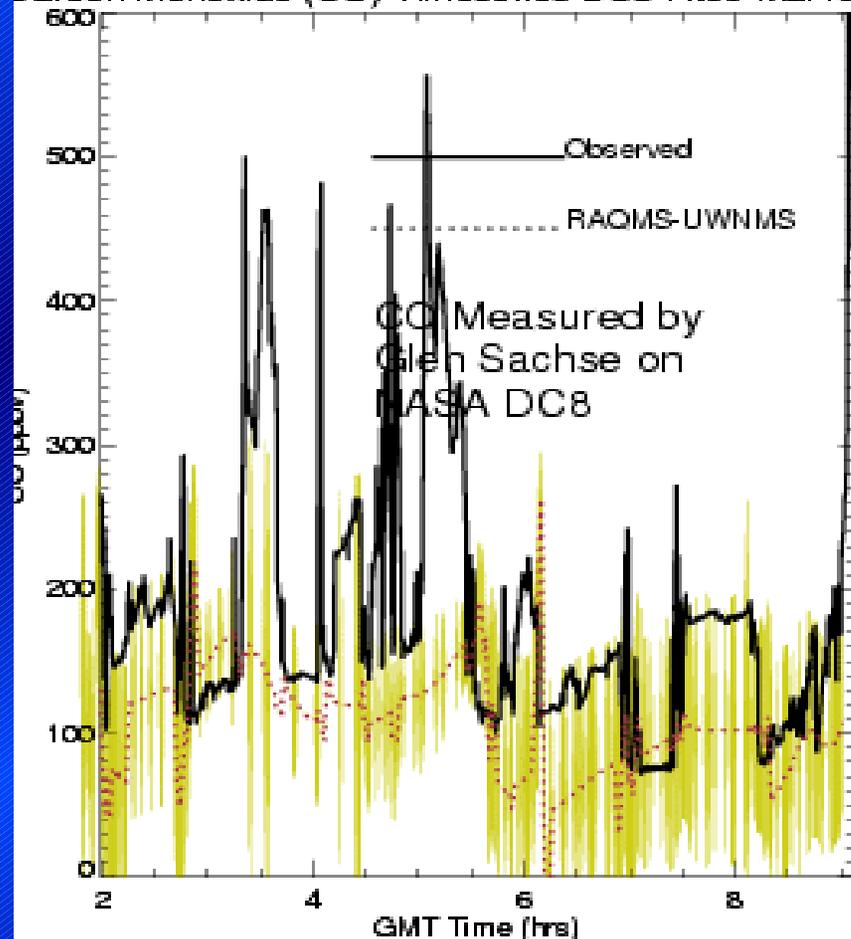


# RAQMS/In-situ O<sub>3</sub> vs CO Comparison

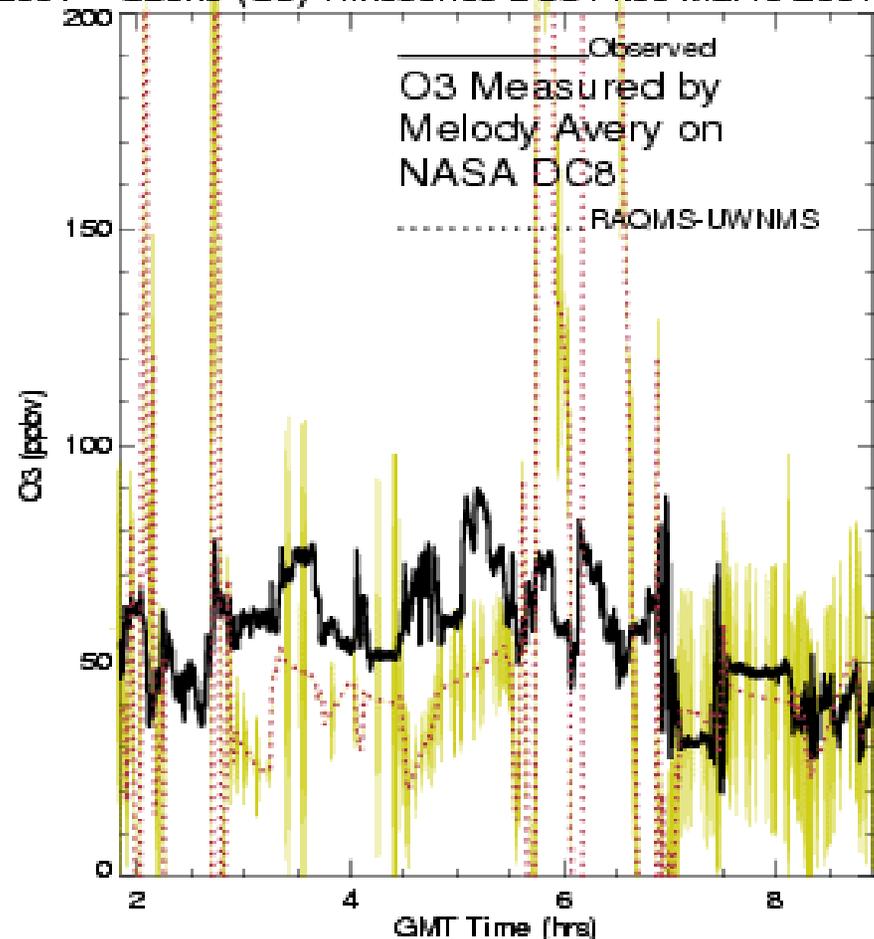


# RAQMS/In-situ Timeseries Comparison

Carbon Monoxide (CO) Timeseries DC8 Flt09 Mar10 2001



Ozone (O3) Timeseries DC8 Flt09 Mar10 2001

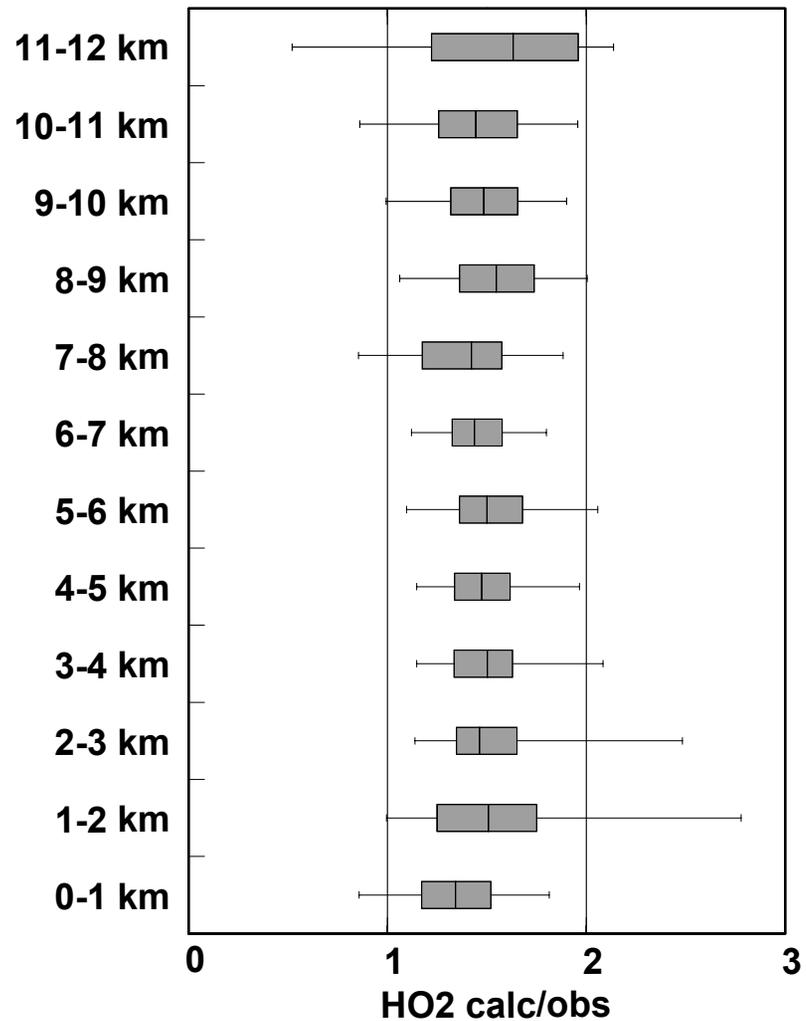
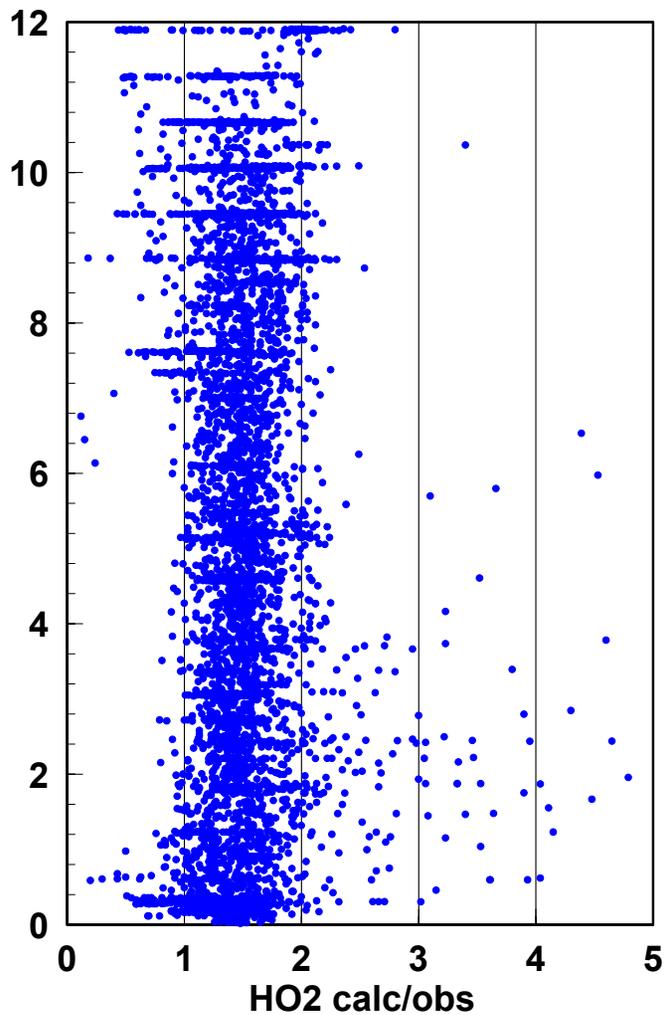


# Time-Dependent Photochemical Box Model

## Calculations: Preliminary Results

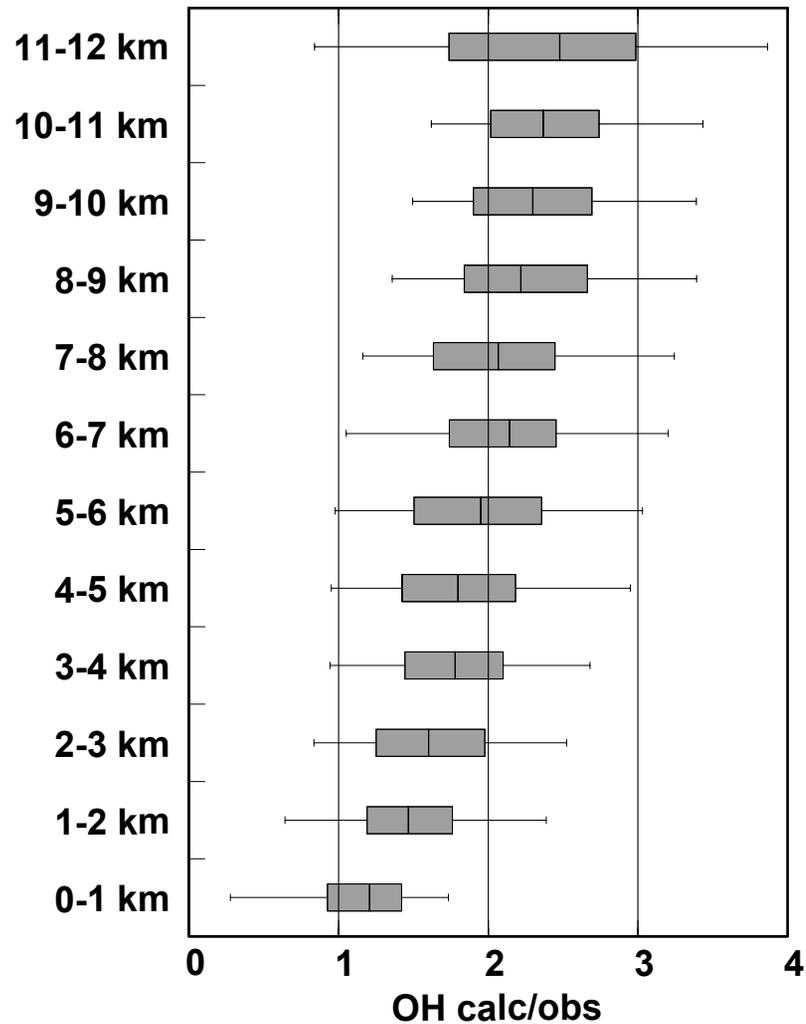
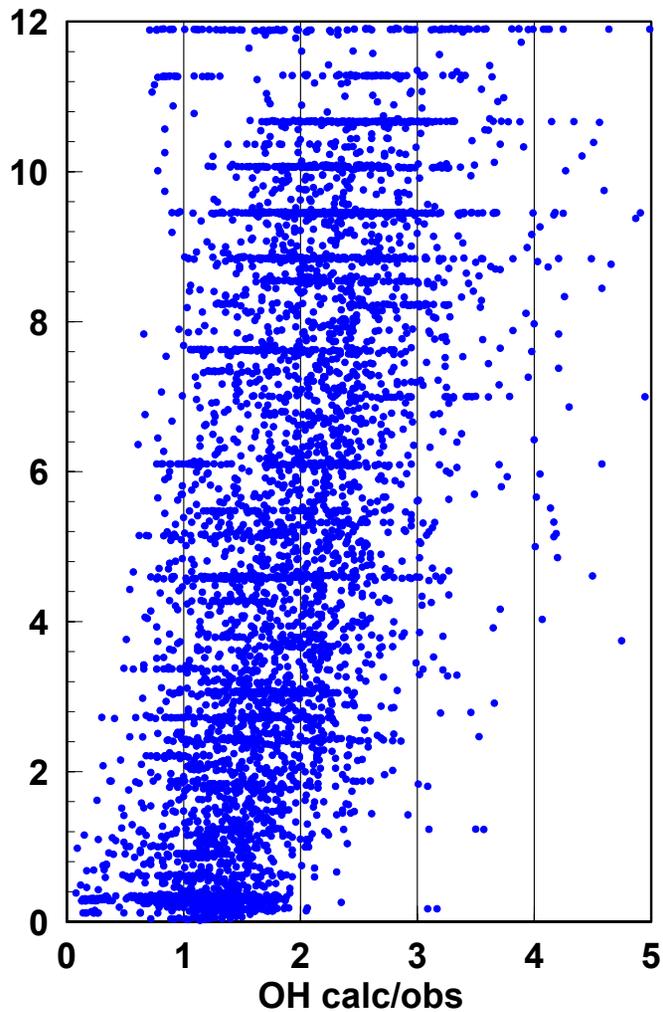
- Most recent NMHC data from Blake
- Oxygenates from Singh (Acetone, MEK, Methanol, and Ethanol)
- No aerosol effects
- NMHC data interpolated for data gaps
- Acetone interpolated for data gaps (>8 km only)

# Calculated-to Observed Ratios for HO<sub>2</sub> vs. Altitude TRACE-P DC-8



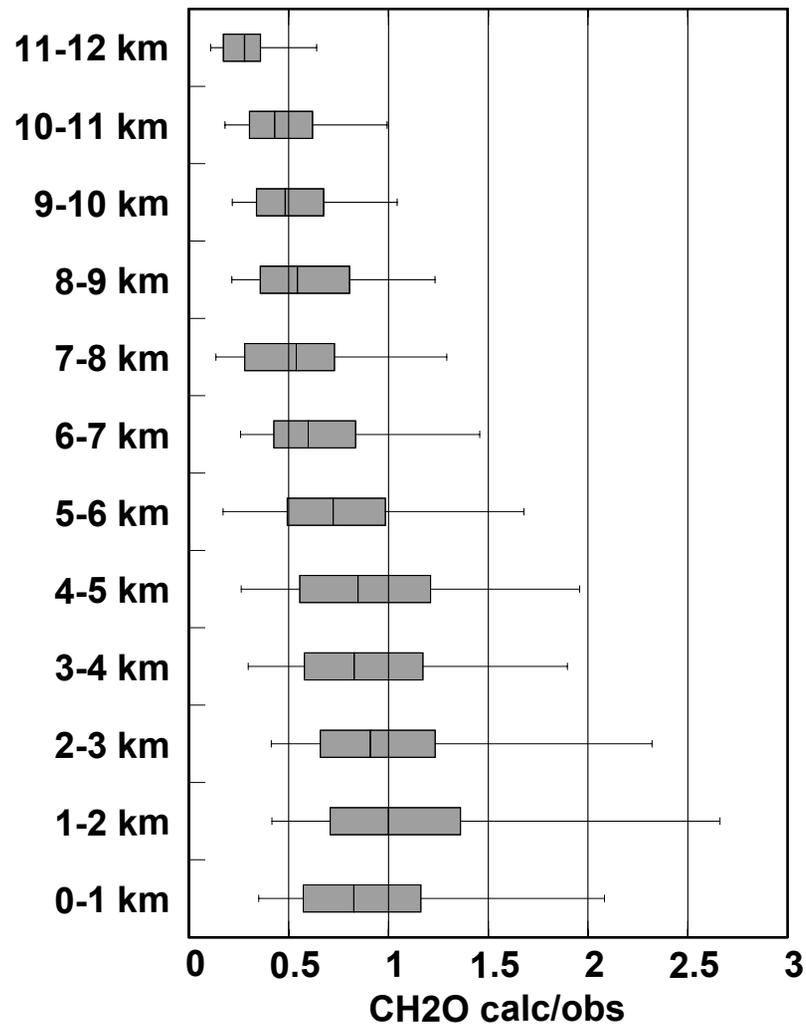
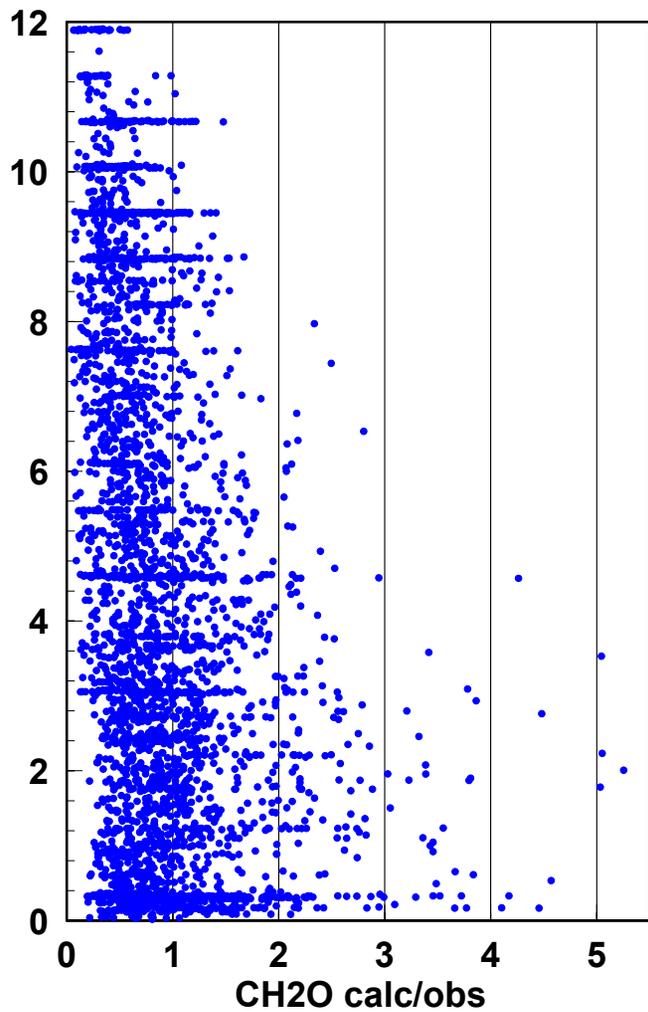
# Calculated-to Observed Ratios for OH vs. Altitude

## TRACE-P DC-8

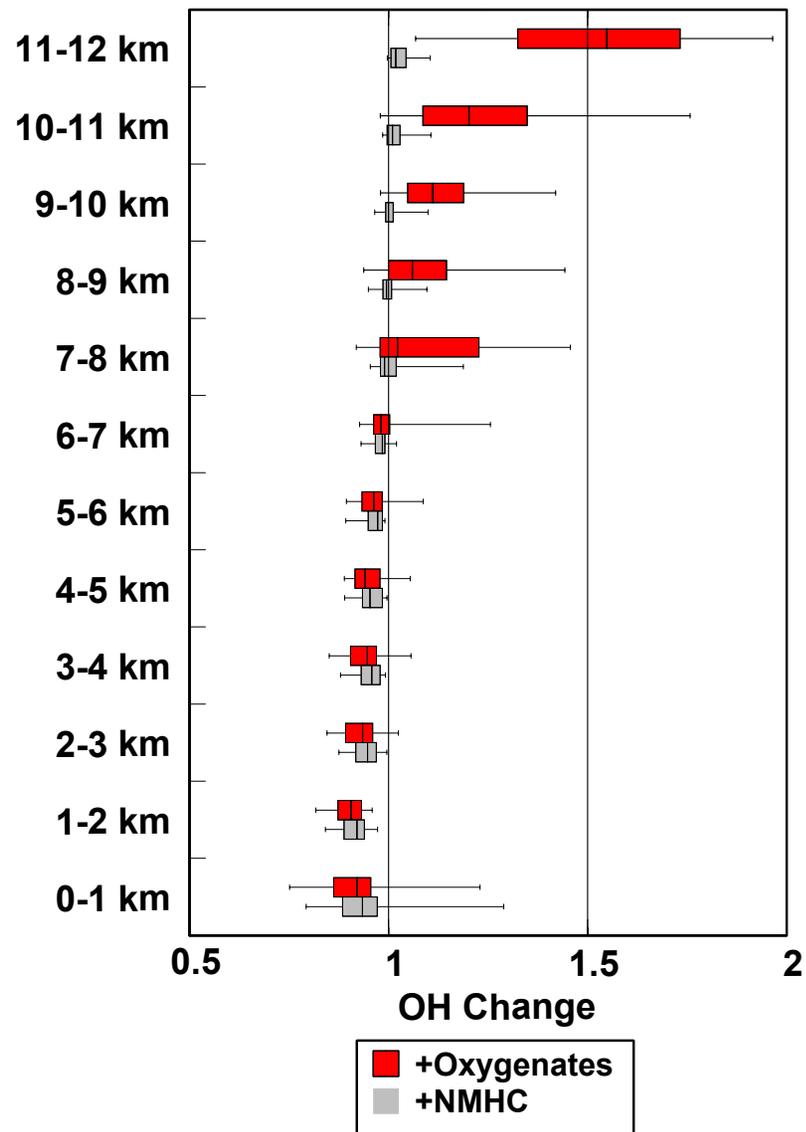
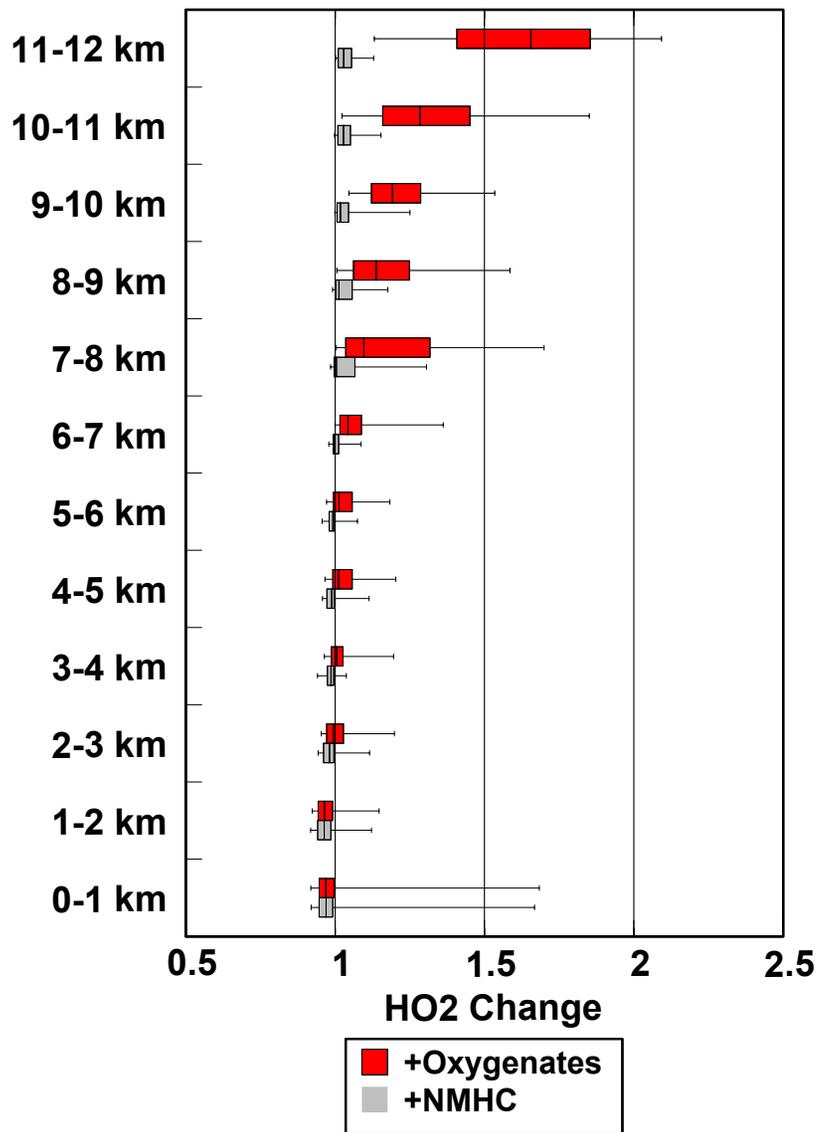


# Calculated-to Observed Ratios for CH<sub>2</sub>O vs. Altitude

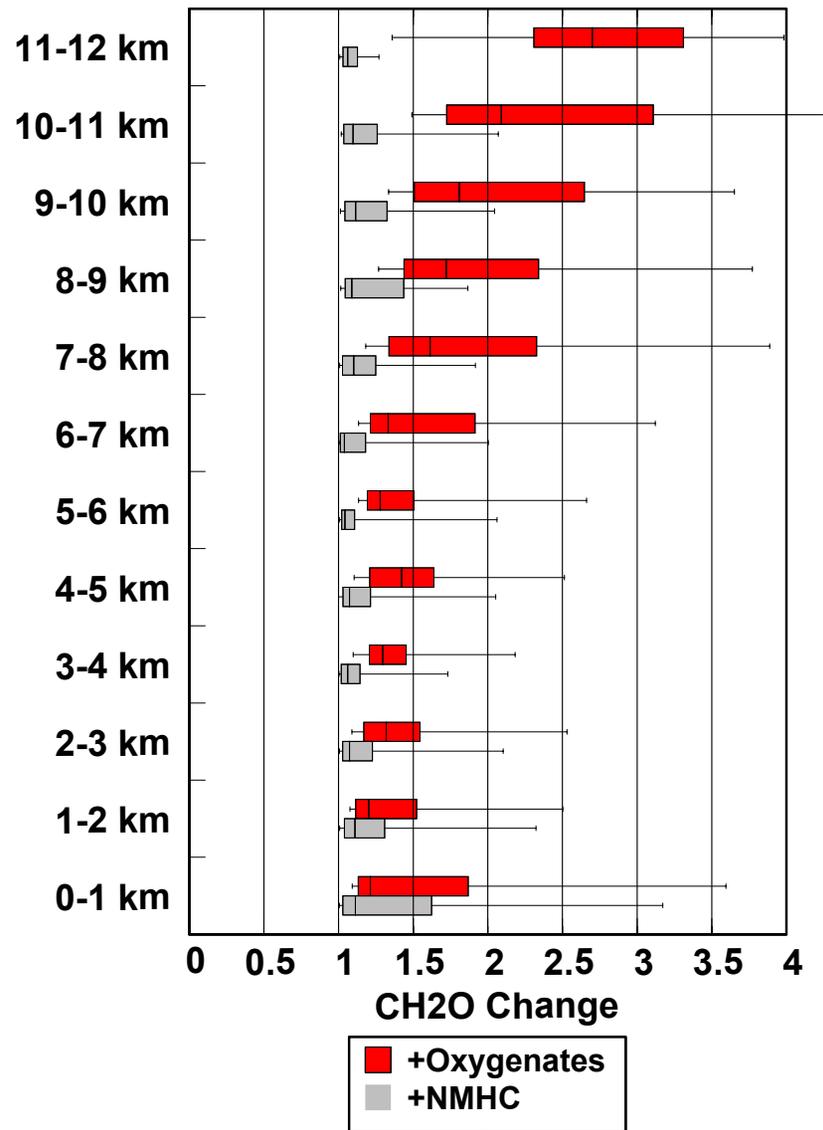
## TRACE-P DC-8



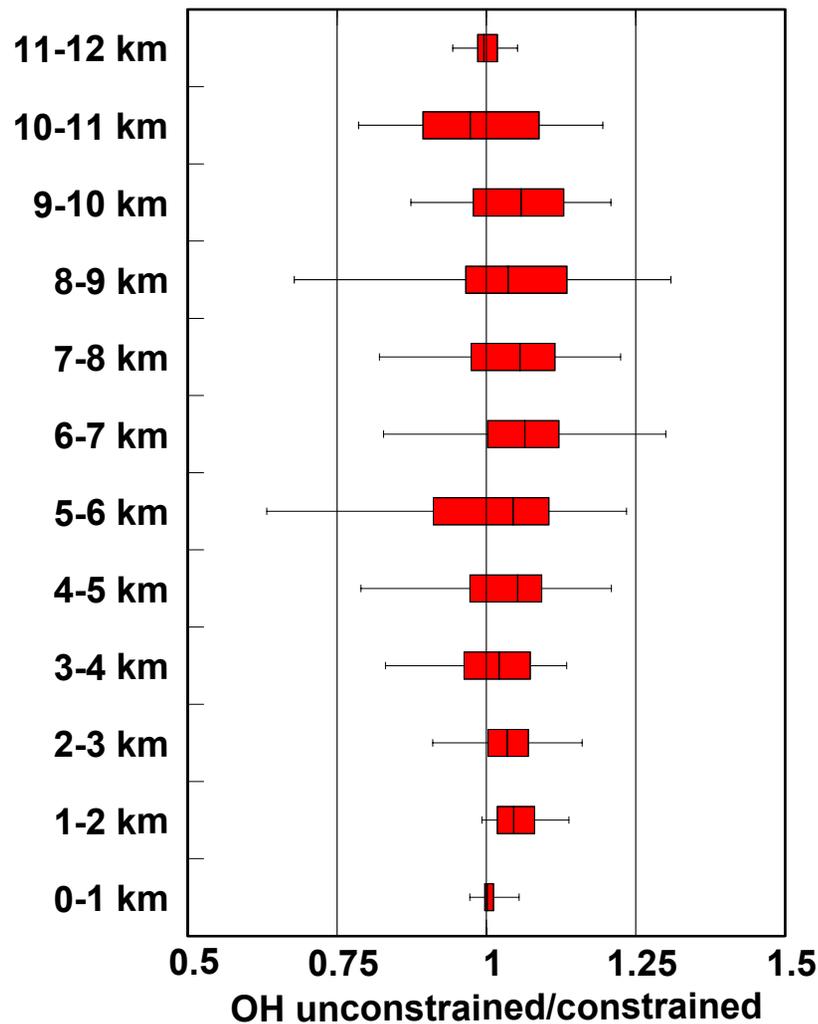
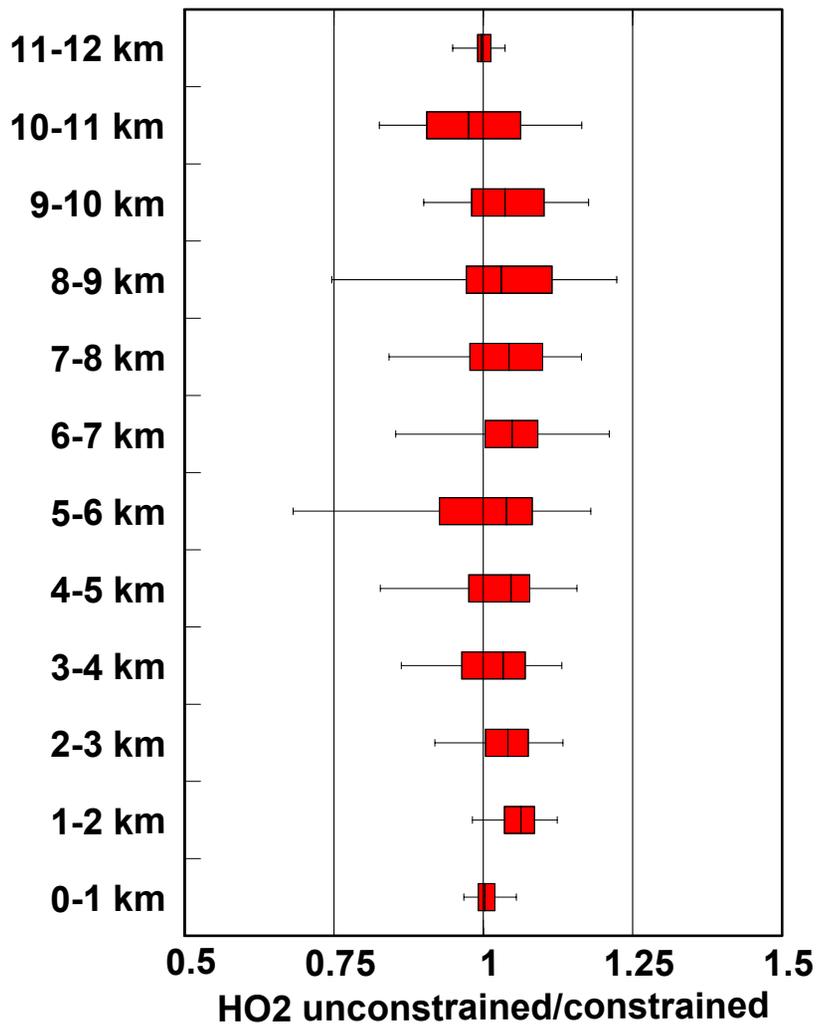
# Sensitivity of Calculated HO<sub>2</sub> and OH to NMHCs and Oxygenated Hydrocarbons, TRACE-P DC-8



# Sensitivity of Calculated CH<sub>2</sub>O to NMHCs and Oxygenated Hydrocarbons, TRACE-P DC-8



# Sensitivity of Calculated OH and HO2 to the availability of H2O2 observations, TRACE-P DC-8



# Comparison of Calculated-to-Observed Ratios of OH and HO2 for the P-3B and DC-8 Aircraft

